




2020

STRATEGIC ANALYSES AND  
ASSESSMENTS OFFICE

# ANNUAL REPORT



An aerial photograph of a multi-lane highway bridge spanning a deep, forested valley. In the background, a city with various buildings is visible, followed by a range of mountains under a blue sky with scattered clouds. The text is overlaid on a dark blue semi-transparent rectangle on the left side of the image.

The Strategic Analyses and Assessments Office supports the 2020 LANL Agenda's major strategic initiatives in the category of excellence in nuclear security. The SAA Office contributes to Agenda Initiatives 1.2, Transform nuclear weapons warhead design and production, and 1.3, Anticipate threats to global security; develop and deploy revolutionary tools to detect, deter, and responds.

## MISSION

*Our mission is to build partnerships through collaboration with Department of Defense, Department of Energy, and across LANL organizations. We work together to increase understanding and analyses of national security challenges, integrate and coordinate across nuclear weapons stakeholders, and educate our stakeholders on the art of the possible.*





# TABLE OF CONTENTS

---

OVERVIEW	4
MISSION	5
PARTNERSHIPS	6
ANALYSES AND ASSESSMENTS	7
CAPABILITY DEVELOPMENT	8
EDUCATION AND OUTREACH	10
WORKSHOPS	12
INTEGRATION AND COLLABORATION	13
INTO THE FUTURE	14
STAFF	14

# OVERVIEW

---

The LANL Weapons Physics directorate (ALDX) created the Strategic Analyses and Assessments (SAA) Office in 2016 to provide analysis to ALDX leadership. The analysis was focused on providing decision support information for guiding strategies for investments, among others. We were founded on a few specific guiding principles. Specifically these principles were to 1) expand simulation capability into broader mission space, 2) deepen existing responsibilities because of mission needs, 3) deepen existing responsibilities to better promote first principle (capabilities,) and 4) favor development with potential for high-value impacts. Since its inception, the office has expanded to include an Action Officer role in support of interagency engagement and an active outreach role for the Department of Defense (DOD), particularly with regard to wargaming and nuclear weapon effects.

We bring together subject matter experts (SMEs) from across the DOD and the National Nuclear Security Administration (NNSA) laboratories to provide senior LANL leaders and the defense community with timely, relevant information on nuclear weapons issues and emerging national security challenges. Our work falls across three principal areas: analyses and assessments; education and outreach; and integration, collaboration, and capability development. We provide value through four main activities: 1) community integration, which supports 2) technical analyses, the results of which are out-briefed in 3) outreach and education activities, and an introspective effort to improve future analysis through 4) staff and capability development advocacy.

The office builds partnerships through collaboration with DOD, Department of Energy (DOE), and across LANL organizations. We work with our partners and stakeholders to increase understanding of national security challenges, integrate and coordinate across nuclear weapons stakeholders, and educate our stakeholders on the art of the possible. The SAA Office outreach activities emphasize partnership through collaboration to build lasting relationships. These relationships guide analytic thinking and help identify and close capability gaps.



Partnership through  
collaboration and  
relationships,  
not transactions

## Analyses

- Resiliency Vulnerability
- Cyber Risk
- Options
- Impacts
- NNSA Laboratories

## Education & Outreach

- Nuclear Weapons Briefings
- Workshops
- EMP Briefings
- HANE Briefings
- Wargaming/TTX

## Integration & Collaboration

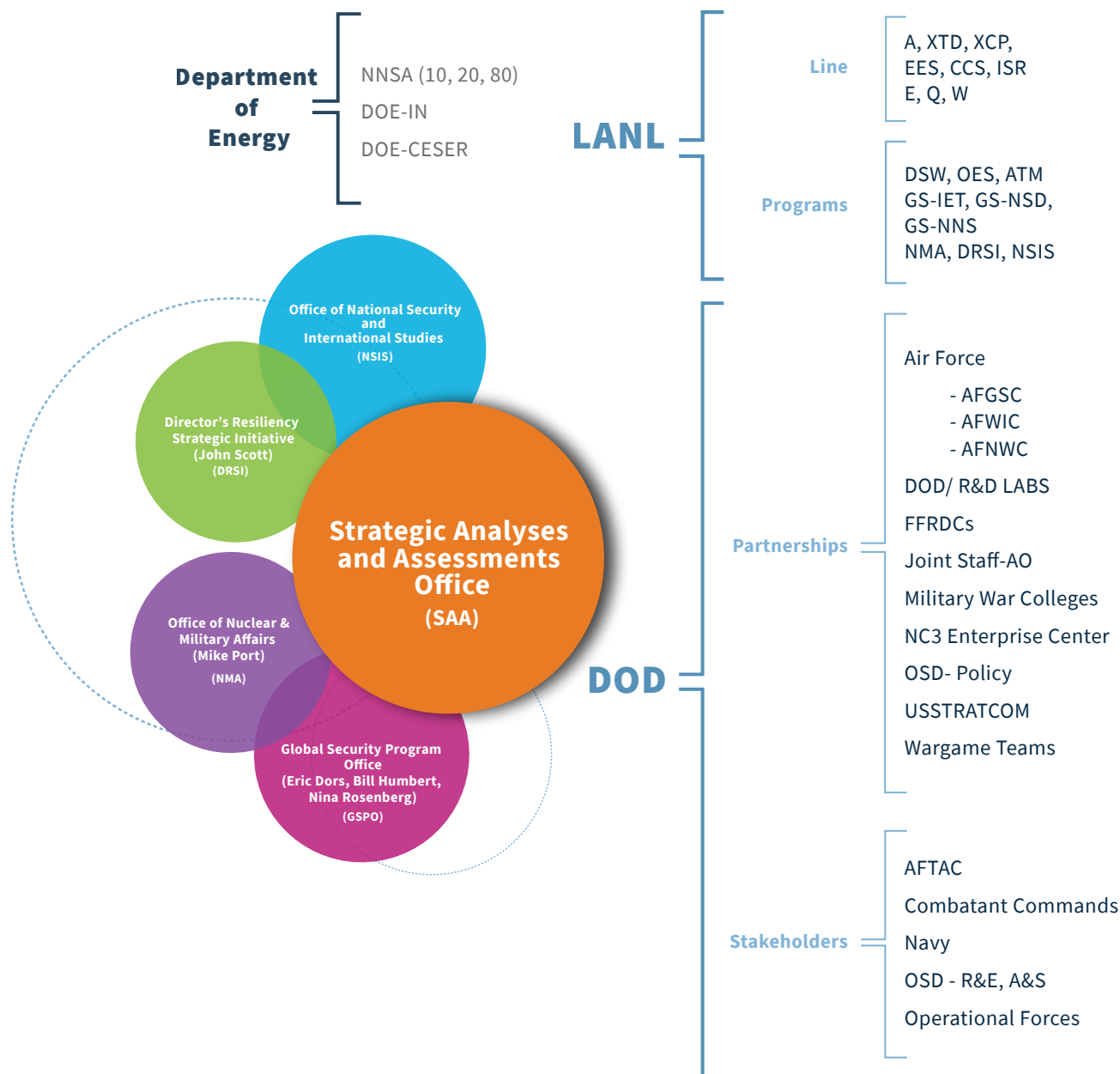
- NWE Coordination
- Inter-lab
- Cross-directorate Coordination
- US / UK



SAA's three principal areas: analyses and assessments;  
education and outreach; and integration, collaboration,  
and capability development.

# PARTNERS

The SAA Office partners with weapons and intelligence organizations within the Laboratory and across the U.S. Government. These partnerships help educate staff on high-fidelity weapons effects and glean feedback to the SAA Office on intriguing problems that our partners face, which, in turn, we use to inform our analyses and assessments. The figure below shows our current internal and external partners.



*SAA works with internal and external partners in support of LANL's mission.*

# ANALYSES AND ASSESSMENTS

The first pillar of the SAA Office focus is analyses and capability development. The office supports three types of analyses: analyses in support of LANL senior leadership, analyses driven by interagency considerations, and triage and rapid response analyses. We facilitate analyses that focus on technical or scientific capabilities that impact U.S. deterrence and we include interagency considerations and questions when developing our studies and analyses, which are supported through existing or new programs. Many of the analyses we perform are intended to inform discussion around potential options for escalation control or restoring deterrence. As can be seen in the figure below, as limited nuclear use considerations enter the conversation, the importance of the details of the effectiveness and consequences become more critical to ensuring the efficacy of the desired result. To support these various activities, we

- Perform analyses utilizing high-fidelity modeling and simulation capabilities at Los Alamos to support detailed understanding of expected outcomes from limited nuclear exchanges;
- Develop and host workshops to bring SMEs together to assess capabilities, gaps, and opportunities; for example, we lead a workshop with the DOD Combatant Command planners to support DOD analyses of conventional-nuclear integration (CNI) considerations;
- Perform focused analysis to support LANL senior leadership and external stakeholders with detailed assessments for nuclear weapon options or effects; and
- Develop analytical activities and products to support larger programs or initiatives at Los Alamos related to nuclear weapon options, effects and impacts, and assessments related to resiliency or vulnerability of systems critical to national deterrence.

# NUCLEAR WEAPON OPTIONS ARE KEY TO STRATEGIC CONFLICT DECISION CALCULUS

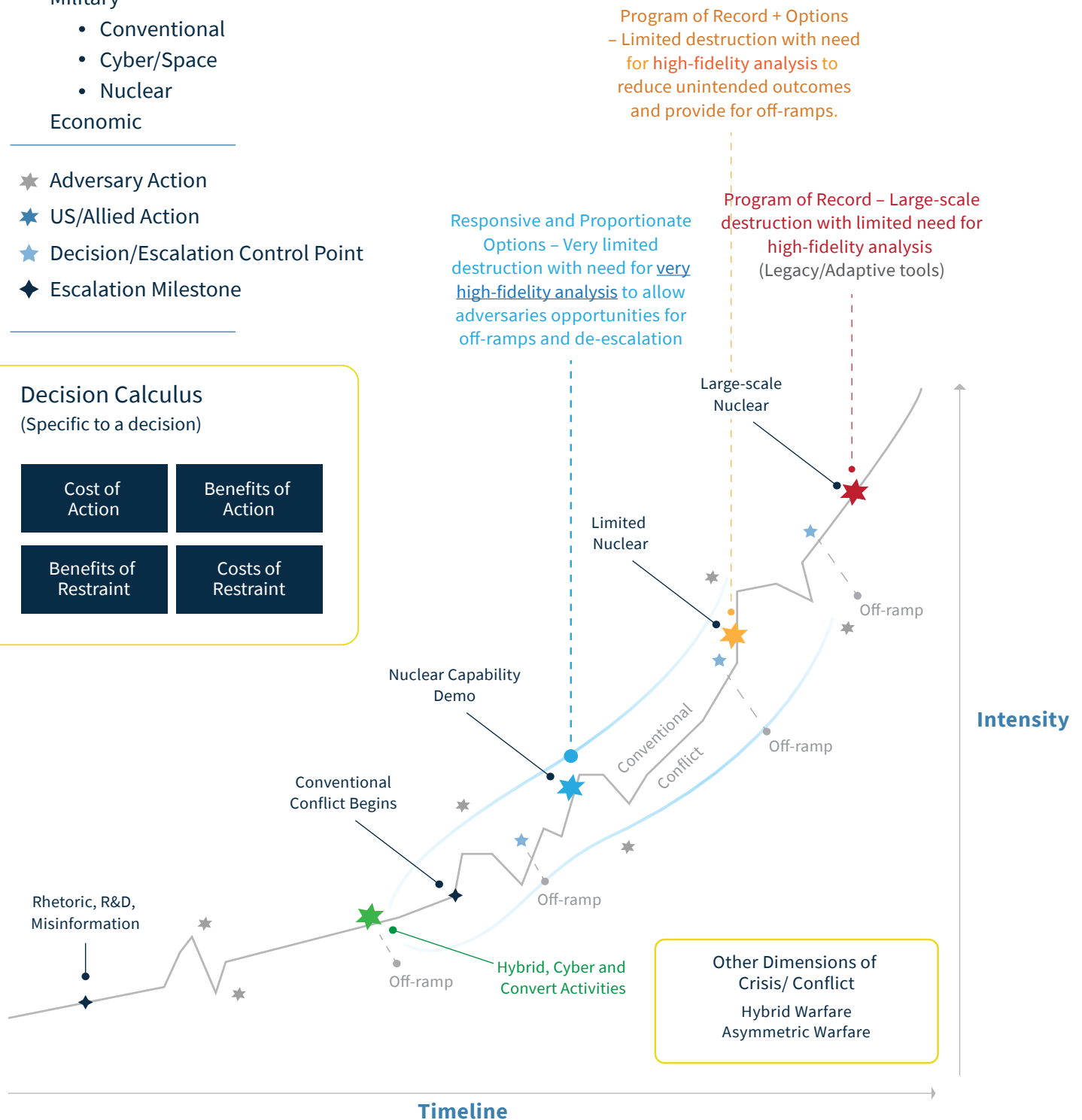
## Integrated Tools

- Diplomacy
- Information
- Military
  - Conventional
  - Cyber/Space
  - Nuclear
- Economic

- ★ Adversary Action
- ★ US/Allied Action
- ★ Decision/Escalation Control Point
- ◆ Escalation Milestone

## Decision Calculus (Specific to a decision)

Cost of Action	Benefits of Action
Benefits of Restraint	Costs of Restraint





Rapid-response analyses last from three to four days; they are intended to help triage analytical questions, focus further analytic activities, or bound the potential outcomes for future analyses. These analyses are directed at questions specific to LANL leadership and rely on existing capabilities and information. They help identify and develop capabilities to address emerging questions from LANL and interagency leadership through integrating people and information from across the laboratory. For example, we examined mission effectiveness using the broad range of nuclear weapons outputs and effects and the impacts to space and ground infrastructure due to high-altitude nuclear explosion. The results of these short activities inform further analysis and capability investments.

## CAPABILITY DEVELOPMENT

The SAA Office and its LANL and Tri-lab (the three NNSA laboratories) partners use analyses results to identify gaps and needed but undeveloped capabilities. Over the past few years, it has become apparent that the nuclear weapons effects community would benefit from new or improved capabilities that the community can use to model blast effects and fire spread. The office facilitated capability development in the following areas:

- **Non-ideal Air Blast (NIAB):** Create a body of work addressing the capabilities of high-fidelity calculations versus fast-running calculations with regard to nuclear weapon effects. NIAB-specific scenarios and situations where the fast running tools are limited or no longer valid in order to directly inform the planning process. The effort also supports the Department of Homeland Security (DHS) Federal Emergency Management Agency (FEMA) as they seek to understand the potential impacts on U.S. urban centers and to help first responders prepare to respond.
- **Supporting the Stockpile Responsiveness Program:** Develop options for nuclear deterrence and possible employment by engaging DOD Combatant Commands. This work is focused on long-range standoff options. The office helped facilitate a meeting with Combatant Commands planners as well as a report presentation to NNSA and DOD stakeholders
- **Working with the Advanced Simulation and Computing Program:** Develop coupling to provide fully coupled fluid/solid capability (weapon effects). This effort will result in a presentation for HARDHAT at the upcoming underground facility working group. In the end this work will provide unique, high-fidelity capability for blast/structure interactions.
- **Supporting the NNSA Office of Nonproliferation and Arms Control (NA-24):** We expanded the high-fidelity tools to explore limited nuclear exchange in support of the humanitarian consequences conversation. This work supports both the Defense Nuclear Nonproliferation (NA-20) and U.S. State Department engagements as well as building capabilities for DHS and FEMA in support of the first responders planning guidance for nuclear detonation.

Infrastructure underpins American society so understanding the effects of weapons on infrastructure is important to hardening it against attack and identifying vulnerabilities. The SAA Office contributed to a few critical infrastructure capability projects this year, including

- Infrastructure network vulnerability due to critical node disruption. This work benefits our energy partners by analyzing mission-critical capability and the most important components to ensure continued function. This effort will provide a software capability to DOD to identify critical nodes to maximize impacts.
- DOE-CESER: Support for March 2018 Executive Order on the risk from electromagnetic pulse (EMP) and geomagnetic disturbances. This effort will result in unclassified reports that can be used in discussions with the inter-agency stakeholders.
- Air Force: Adapting infrastructure capabilities for DOD support on critical infrastructure analysis. This effort will deliver new capability to the U.S. Air Force to assess the resilience of critical functions connected to commercial power.

Over the past year the office has led or contributed to several additional studies including:

- Assessment of the potential new threat posed by Russian expansion of nuclear weapons capabilities, particularly the underwater and nuclear drone described by President Putin in his March 2018 annual address.
- Workshop to examine risks and vulnerabilities to the strategic deterrence of the United States, in support of the LANL Director's Strategic Resiliency Initiative.
- We applied our skills to facilitate a multi-laboratory weapon modularity study. Contributors to this work came from Lawrence Livermore National Laboratory, LANL, Sandia National Laboratories, Kansas City National Security Campus, and the PANTEX and Y-12 sites of Consolidated Nuclear Security. Due to travel restrictions, the study was coordinated through virtual meetings at the unclassified level, a new challenge to overcome.
- Assessment of developing options for delivery systems in a hedge. The Program of Record is a long-term solution designed to modernize our existing deterrent structure. The SAA Office is exploring options that would be available if there are any technical, budgetary/programmatic, or geopolitical issues that require a new capability to be developed and deployed quickly to respond. This strategy is our hedge against an uncertain future where deterrence must still be assured. The report and presentation will support NNSA and DOD.

## EDUCATION AND OUTREACH

The second pillar the SAA Office focuses on is education and outreach. We work with DOD and other federal organizations to understand the tactics, techniques, and procedures that are considered when planning for a nuclear exchange. We also advise and participate in wargames, table top, and other exercises, providing insight to consider gaps and future mission capabilities and options.

The SAA Office is involved in several of the most important nuclear use war games. War games investigate high-level strategic and deterrence concepts or low-level operational, logistical or tactical plans. In the past few years, there has been an increase in the number of high-level games that have included operate-through nuclear use. These games seek to integrate systems survivability, CNI, and mission effectiveness concepts to help understand future domestic and adversary nuclear posture and to gain insights into possible courses of action. The premier games usually involve hundreds of people from across many DOD organizations. Frequently the Intelligence Community and other relevant agencies also participate, thus, the game represents a microcosm of the U.S. Government.

The impact of the SAA Office on the DOD wargaming community can be measured by the increased activity we have in FY2020. Including the following:

- Secured a contract from DTRA to fund our participation in a few prominent wargames (especially Air Force Futures games). DTRA wants to support more war games and needs our subject matter expertise to do so.
- Participated in several of the setup activities and outbriefs for the futures games and actively engaged LANL Air Force Fellows and the Intelligence Community in the process. We provided SME expertise in the WMD adjudication efforts.
- Participated in the lower tier Joint Land Air Sea Space (known as JCLASS) game hosted by the AF Lemay center on the APAN.org website and the Army Future Commands wargame: Calibrated Force Posture Experiment. Both were non-nuclear employment, but both had interesting (if short) discussions about nuclear usage.
- Engaged with the Schriever Space force war game staff. LANL was invited and went to Schriever (Colorado Springs, CO) to present LANL capabilities that would benefit the Schriever game to Brian Raymond (Deputy Director, Schriever Wargame). They were interested and invited LANL to participate in 2020; an invitation LANL has been seeking for several years.
- Visited the Navy War College and gave a Department seminar on weapon effects and options. This activity maintains close ties to the organization that runs the Title X DEGRE wargame for U.S. Strategic Air Command (USSTRATCOM). In 2019, the SAA Office deputy director served as the lead for the WMD adjudication cell for that game.

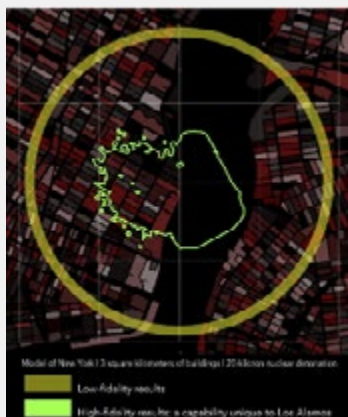


LANL was the only NNSA organization invited to participate in 2019. We also provided an introduction to a DTRA colleague to help establish those ties and gained an invitation for DTRA to attend. The game was cancelled due to COVID-19 in FY2020.

- Participated in the Global Engagement planning event in Bossier City, LA. We were scheduled to participate in GE capstone in PACOM, unfortunately the event was cancelled due to COVID-19. This participation did begin a new collaboration with PACAF that resulted in their active participation in the ongoing Combatant Commands workshop.
- Participated in the Weapons and Tactics Conference (known as WEPTAC) CNI Focus group at Nellis Air Force Base, again LANL was only NNSA participant. This event illustrated the need for leadership in the CNI activities, and formed the basis for what content should be presented in a LANL deep-dive of the DEGRE 2018 game in the future.

Over the past year, the SAA Office provided briefings on a variety of topics to several of our partners and stakeholders, including USSTRATCOM, Air Force Global Strike Command, Office of the Secretary of Defense (OSD), and the White House. These topics include:

- High-fidelity analyses of EMP and mission effectiveness were presented to various leadership level across the DOD in partnership with Sandia and Livermore National Laboratories.
- Potential impacts of Russian underwater nuclear drones to the U.S. Strategic Deterrence enterprise.
- High-fidelity weapon effects analysis for both mission effectiveness and consequences of execution for DOD and DHS planning purposes.



*High-fidelity modeling in 3D of EMP effects (green) shows a significant increase in predicted accuracy over low-fidelity 2D modeling (yellow).*

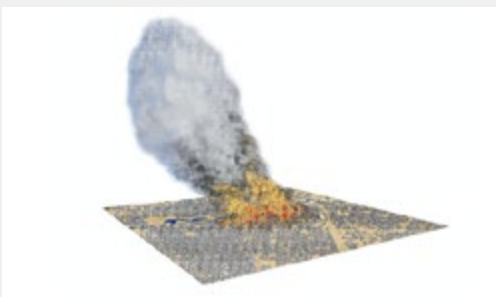


*High-fidelity modeling of radiation effects (green) on a population center provides greater predicted accuracy over low-fidelity 2D modeling (yellow) that assumes no buildings or boulevards. Although the low-fidelity results are a useful, conservative estimate, they provide inadequate fidelity for detailed planning.*

# WORKSHOPS

One of the goals of the SAA Office is to educate LANL's early and mid-career staff about nuclear weapons effects and the art of the possible. To that end, we sponsored and facilitated the three workshops.

- **Art of the Possible** – The drivers inspiring this “Art of the Possible” workshop were the 2018 Nuclear Posture Review and need for next generation designs. The objectives of this workshop was to educate and to bring together a community of designers in ALDX, engineers in Weapons Engineering, and global security specialists in Global Security. We invited late early-career (three to five years’ experience generally) scientists, engineers and Intelligence Community staff to the workshop. Our intent was to provide a uniform education and message to this community on the importance of the stockpile to U.S. and DOD; how the U.S. stockpile evolved with time, the specific outputs and effects this stockpile had and why; the current and future threats; what types of outputs a system can have; what are the impacts on hard targets; and finally, based on what we heard, how could we develop future optimized weapon options. The classified report following the workshop captures the gaps, needs, threats, potential design options, and paths forward identified by these future leaders.
- **Extended Spectra** – The SAA Office held a day-long workshop to understand various stakeholder’s needs and LANL’s capabilities in extended spectra. Staff from Computational Physics (XCP); Theoretical Design; Computer, Computational, and Statistical Sciences (CCS); Theoretical, Intelligence and Space Research, and Earth and Environmental Sciences Divisions discussed their capabilities and current related research activities. XCP and CCS staff demonstrated hydrodynamic calculations that extend out to the time scales of interest, and even equation of state work performed in FY19 that incorporated Lawrence Livermore National Laboratory data into LANL codes that now match detonation observations.
- **Combatant Commands planning conference** – The SAA Office, in partnership with our sister organization, the Nuclear and Military Affairs Office, and the Stockpile Responsiveness Program, organized a three-day conference to guide thinking around potential needs and weapon options. Participates included DOD HQ (OSD, OPNAV, Joint Staff, Air Force), NNSA, and DOD Combatant Commands (EUCOM, SOCOM, CENTCOM, INDOPACOM, and USSTRATCOM).

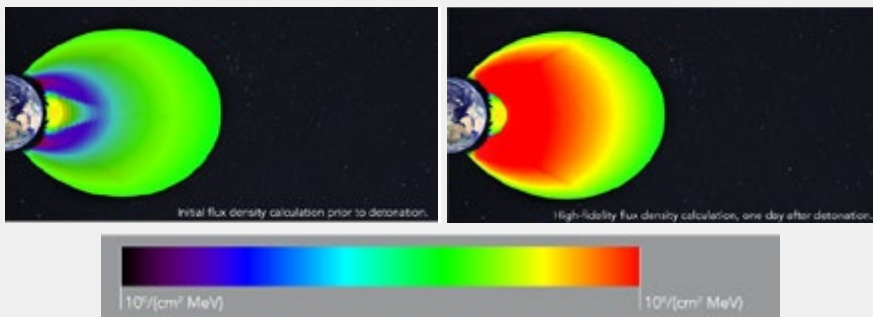


*High-fidelity and 3D modeling, using current climate and infrastructure data, supports accurate strategic planning for the effects of nuclear-induced firestorms in urban environments (Atlanta, GA, shown here). The details of the evaluation is critical to informing infrastructure and humanitarian consequences.*

# INTEGRATION AND COLLABORATION

The third pillar of the SAA Office focuses on connecting stakeholders to subject matter experts who can help them identify and solve nuclear weapons deterrence challenges, including nuclear weapons effects and inter-laboratory coordination, U.S. government engagement, and performance and effectiveness strategic collaboration (i.e., Atomic Weapons Establishment, U.K. Ministry of Defense, NNSA, DOD). Over the past year, we have collaborated with the following organizations:

- Defense Threat Reduction Agency (DTRA) reachback—The SAA Office works with LANL’s DTRA program office to support DTRA Reachback. In FY20, this work focused on creating a plan to incorporate fast-running LANL fire growth and propagation into reachback fire tools and evaluating the iron source vs full fidelity simulations. DTRA reachback is a 24/7 support service that provides first-order predictions and evaluations within hours from the request. They are the only entity at DTRA that continues to operate in-office, due to the high priority nature of their work. Reachback recognizes the limitations of their tools and they seek to develop a high-fidelity reachback capability that leverages LANL and, thus, the NNSA Tri-Lab capabilities going forward.
- USSTRATCOM rotation – In 2020, the SAA Office started a regular rotation to USSTRATCOM to provide education and reachback to the planning and evaluation divisions. After meeting with several candidates who were identified by LANL line managers in the Weapons and Science, Engineering, and Technology Directorates, we identified six people who had the background, personal and communications skills, and required clearance and access to staff this initiative. The rotation began in January. Although travel was curtailed due to the COVID-19 pandemic, we resumed the rotation in June 2020 because LANL senior leadership deemed this work to be mission-essential. We expect to build on the success of this program and extend it to other interested combatant commands.



*Fission products from high-altitude nuclear detonations create radiation belts that can degrade and kill satellites. High-fidelity modeling of these evolving belts enables improvements to satellite-hardening standards and other defensive measures.*



# INTO THE FUTURE

The SAA Office will begin FY21 as part of the National Security and International Studies (NSIS) Office. The NSIS Office serves as a resource for the Laboratory Director and senior management on key policy matters relevant to LANL's mission. The scope of the Office includes nuclear weapons policy, nuclear strategy and deterrence, nuclear nonproliferation, counter proliferation, arms control, WMD terrorism and emerging threats from cyber and hybrid warfare. NSIS provides technology policy analyses of current global security topics to enhance understanding and to support strategic planning and program development efforts across the Laboratory. Combining the SAA Office with NSIS extends the capability of NSIS in providing insight to LANL senior leadership while strengthening the internal collaborations that the SAA Office has developed over the past four years.

## STAFF

**James H. Cooley, *Director***

**Tim Goorley, *Deputy Director***

**Daniel B. Garcia, *Weapons Design Analysis Coordinator***

**Chris Scully, *Weapons Engineering Design Coordinator***

**Lisa Inkret, *Project Manager***

**LA-UR-20-29804**

### Disclaimer:

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by Triad National Security, LLC for the National Nuclear Security Administration of U.S. Department of Energy under contract 89233218CNA000001. By approving this article, the publisher recognizes that the U.S. Government retains non exclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes. Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy. Los Alamos National Laboratory strongly supports academic freedom and a researcher's right to publish; as an institution, however, the Laboratory does not endorse the viewpoint of a publication or guarantee its technical correctness.

